An inspection of this table will show at once that considerable advantage is to be gained by the careful selection of flying levels. It is strikingly illustrated by the Chicago to Omaha flight. By flying low toward Omaha much time could be gained, on this occasion almost two hours could be saved, by flying at the 1-kilometer level instead of the 3-kilometer level. On the journey from Omaha to Chicago about an hour could be saved by flying high. Differences in time as great as an hour are of considerable importance in the delivery of mail, especially in the case of the relay system, in which the mail is taken from the plane at Omaha and placed on the train. If a certain train is missed, there may be another two, three, or four hours lost before the mail would get out of Omaha for the West. Indeed, the minutes are important in the making of connections with railway trains.

Another interesting situation might occur occasionally, which would show how the meteorologist's skill and ingenuity could be brought into play. To illustrate the type of situation in mind, suppose there is a low-pressure area centered north of the Great Lakes, in such a manner that there are northwest winds blowing at Chicago and southwest at New York. A dirigible capable of 64 miles per hour in still air is to fly from Chicago to New York. Let us assume the radius of the curvature of the wind path through Chicago and New York is 500 miles, and that the gradient is such as to produce approximately a steady upper-air wind of 50 miles per hour. It is seen that the speed of the ship will be higher if it follows the curved wind path, rather than cuts across isobars, as it were, in a straight line to get to its destination. In this case, its forward speed along the wind path would be about 114 miles per hour, along the straight line about 102 miles per hour on the average. The path of the faster course is longer by about 50 miles than the path of slower travel. But by following the curved path the dirigible will arrive in New York about 20 minutes earlier than if it attempts to cut across.[13] This gain is in this example not particularly important although it is representative of what might occur and the type of judgment the aeronautical meteorologist might be called upon to possess.

The value of such an organized system of detailing the information lies, as was suggested in the beginning, in the increase of safety in flying and in the increased economy in the maintenance of schedules and in overhead expense. A consistent program of detailed meteorological information would undoubtedly effect tremendous financial savings, when the large fuel expenditure alone is taken into consideration.[14]

CONCLUSION.

It will suffice, in conclusion, to review briefly the essential points of the discussion. An effort was made to show that a consideration of the weather factor in aeronautics must lead to beneficial results in commercial aviation; and that the requirements of commercial aviation must eventually bring into being the vocation of aeronautical meteorologist. For the Weather Bureau, there will always be the domain of public service, even with respect to aeronautics, which no private enterprise could possibly usurp; and that domain is the collection and dissemination of current and climatological meteorological information, and the conduct of organized research. The accurate reduction of atmospheric pressure to levels in the free air must, if it is successfully accomplished, result in untold value to aviation. A governmental agency is the only one that can accomplish this. And this leads to the theme which, while it can not grow old to those interested in upper-air research, has often been seen in these columns, and that is the necessity for an enlarged program of aerological observation. The rôle of meteorology in aeronautics is not a minor one, important as are many others; and it is a safe prediction that the development of commercial aeronautics will evolve the methods for giving the necessary consideration to the weather factor.

[13] "Undoubtedly captains of the big aerial liners of the future will become wily and cunning masters of the art of selecting the right way and the right height and often, by making wide *détours*, will, by their air knowledge alone, save many hours on long sea and land passages."—Big. Gen. Maitland, in the log of the R.34. *Commercial Airships*, Pratt. Appendix, p. 231.

[14] Report of Air Mail Service, October, 1920, *Aviation*, Jan. 10, 1921, p. 51. Cf. also DeHaviland on Civil Aviation, *Aerial Age Weekly*, Jan. 17, 1921, p. 486.

CERTAIN RELATIVE INSOLATION VALUES.

By W. J. HUMPHREYS.

The brief table of relative insolation values given on page 20 of Davis's *Elementary Meteorology*, and copied on page 80 of Humphreys's *Physics of the Air*, has recently been questioned by Prof. R. D. Calkins of the Central Michigan Normal School, Mount Pleasant, Mich.

This table indicates that, neglecting atmospheric absorption, or at the limit of the atmosphere, the amount of solar energy delivered per day per unit horizontal surface is greater at the Equator at vernal equinox than at autumnal equinox; this is correct, and is because the earth is nearer the sun on the former date than on the latter.

The table further indicates that at 20° north latitude less insolation is received during the day at vernal than at autumnal equinox; this is an error. Insolation is greater at vernal than at autumnal equinox at all parts of the world. Finally, the table indicates that no insolation is received during the day at winter solstice at 60° north latitude. This obviously is an error since latitude 60° N. is still considerably short of the arctic circle.

It therefore seemed worth while, perhaps, to recalculate the entire table. This was done, using the data of the Nautical Almanac for 1921, and the results are given, with Prof. Davis's kind approval, in the accompanying table. The *yearly totals* are reduced from values given in a different unit by Angot, *Annales du Bureau Central Météorologique*, for 1883.

Relative values of total diurnal insolation per unit horizontal surface at the limit of the atmosphere.

Latitude.	Equator.	20° N.	40° N.	60° N.	North Pole.	South Pole.
Vernal equinox	1.000	0.940	0.766	0.500	0.000	0.000
Summer solstice	0.882	1.044	1.107	1.093	1.201	0.000
Autumnal equinox	0.987	0.927	0.756	0.494	0.000	0.000
Winter solstice	0.941	0.676	0.357	0.056	0.000	1.283
Annual total	348	329	275	198	144	144